Section 9 Contents

Section 9 State Water Plan - Cedar/Beaver Basin

Water Planning and Development

9.1 Introduction

This section describes the major existing and proposed water planning and development activities in the Cedar/Beaver Basin. The existing water supplies are vital to the existence of the local communities while also providing aesthetic and environmental values. State, federal and local agencies as well as other interested parties need to coordinate their activities regarding water resources.

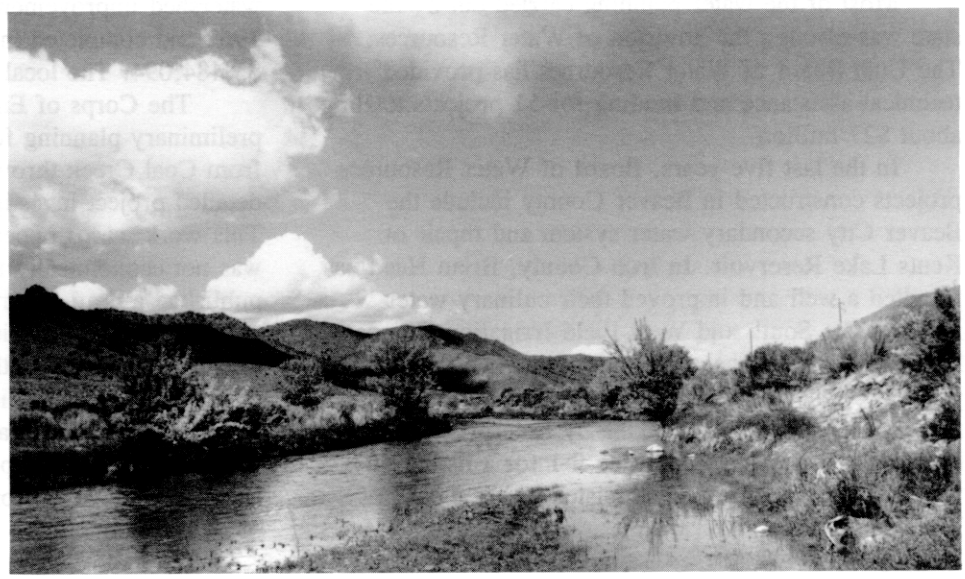
One goal of the Utah Division of Water Resources is to assist other state and federal agencies in effective, coordinated, water-related activities. However, the decision making process is still the responsibility of the local people. This plan provides local decision makers with data to solve existing problems and to plan for future implementation of the most viable alternatives.

9.2 Background

Development in the 1850s was by groups of individuals with a common cause. It was a matter of surviving in a newly settled area. Later, it was found more convenient to organize formal groups such as irrigation companies and cities and towns. Since then, a water conservancy district has been formed covering the Washington County part of the basin. There are also a variety of other entities, such as special service districts, that have been formed to develop needed water and related resources.

As demands for municipal and industrial (M&I) water increase, supplies will come primarily from agricultural water right transfers, drilling new wells and conservation. Additional water supplies could come from transbasin diversions and cloud seeding activities. Of the total water diverted for all uses, (not including riparian vegetation and wetlands) about 96 percent is for

■ Water development, with conservation, is essential to meet the demands and needs of the future. This requires wise planning and the cooperation of all government agencies and local organizations.



Beaver River below Minersville Reservoir

agricultural purposes, including livestock watering needs. As other uses increase, this percentage will decrease. The current diversion for M&I water is 3 percent, but this will increase in the future, especially in Cedar Valley. Single family domestic and secondary uses are about 1 percent.

9.2.1 Past Water Planning and Development

At the time of the earliest settlements, individuals and groups generally did their own planning and development of the water needed for various uses. Later, technical and financial assistance became available from state and federal agencies.

Many projects and facilities have been constructed over the years to develop the needed water resources. Seven storage reservoirs with capacities over 1,000 acre-feet have been constructed, primarily for irrigation purposes. See Table 6-1 for a detailed listing of existing reservoirs. Many smaller reservoirs for single and multiple purposes have been built for irrigation, flood control, stock watering and fishing. The total surface water storage capacity in the basin is about 47,000 acre-feet.

Other past developments include canal lining, pipelines for irrigation and culinary water supplies, storage tanks, wells, secondary water systems, diversions and sewage lagoons. One early project, which is now abandoned, was construction of a canal to divert water from the Sevier River drainage of Brian Head Peak into Parowan Valley. More recently, needed flood control structures and flood channels have been constructed.

Most of the water planning carried out by the state was through the Division of Water Resources. The Utah Board of Water Resources has provided technical assistance and funding for 51 projects totaling about $27 million.

In the last five years, Board of Water Resources projects constructed in Beaver County include the Beaver City secondary water system and repair of Kents Lake Reservoir. In Iron County, Brian Head has installed a well and improved their culinary water system. The South and West Field Irrigation Company has installed a low-head irrigation pipeline. The last project installed in the Washington County portion of the basin (1982) was a pipeline by Enterprise Reservoir and Canal Company. See Table 9-1 for a listing of water development projects assisted by the Board of Water Resources.

Other projects have been carried out through the Agricultural Conservation Program and the Agricultural Resource Development Loan program. These include sprinklers, pipelines and other agricultural-related projects.

The Soil Conservation Service (now Natural Resources Conservation Service) spent considerable effort planning for a proposed watershed project in the Cedar City area. This covered the drainages from Shurtz Creek on the south to Parowan Creek on the north. The project was to reduce erosion; provide sediment, floodwater and irrigation water storage; and conveyance systems and onfarm improvements. Planning was terminated because the estimated high development cost made the project infeasible.

Two major projects were completed by the Soil Conservation Service (NRCS). One, Green's Lake Watershed Project near Cedar City, was a flood control project. It consisted of five debris basins and related floodwater channels to protect the south side of Cedar City. The upper watershed was also treated by brush and tree removal and reseeding with grass to reduce erosion and floodwater runoff. This project was started in 1957 and completed in 1962 at a cost of $290,357. The only local cost was for easements and rights-of-ways. The value of this project has increased because of expansion of the residential and business area.

The second was the Minersville Watershed Project, constructed to prevent and control floodwater and sediment deposition, increase irrigation efficiencies and improve the upper watershed areas. The project consisted of debris basins, concrete pipelines, canal lining, sprinkler and flood irrigation systems, and upper watershed improvements. The project was started in 1962 and completed in 1978 at a total cost of $5,484,094. The local cost was $3,105,007.

The Corps of Engineers carried out some preliminary planning for controlling and passing floods from Coal Creek through Cedar City in 1977. A detailed project investigation was initiated in 1978. This work was dropped in 1980 because the project was not economically feasible. The Corps recently published a draft report presenting the findings of flood control investigations in the Sevier Lake drainage.[10] They have concluded that although there were flood threats to the Cedar City area, there were no potentially feasible flood control alternatives.

The Corps completed a flood control project on Big Wash above Milford in 1961. This project consists of a diversion dam 34 feet high and 2,400 feet long,

Table 9-1
BOARD OF WATER RESOURCES DEVELOPMENT PROJECTS

Sponsor	Type	Year
BEAVER COUNTY		
Abadare Canal Company	Irr-Well	1961
Beaver City	Cl-Tank	1977
Beaver City	Ss	1990
Harris-Willis Irr. Co.	Spk	1984
Kents Lake Reservoir Co.	Dam-Res	1948
Kents Lake Reservoir Co.	Dam-Rep	1952
Kents Lake Reservoir Co.	Dam-Rep	1973
Kents Lake Reservoir Co.	Dam-Rep	1977
Kents Lake Reservoir Co.	Dam-Rep	1994
Manderfield Cul. Water Co.	Cl	1977
Manderfield Irrigation Co.	CNL	1963
Milford City	Cl-Well	1976
Minersville Res. & Irr. Co.	Pr-Pipe	1972
Minersville Res. & Irr. Co.	Div-Dam	1987
Minersville Town	Cl-Well	1976
Rocky Ford Irrigation Co.	Dam-Res	1953
Rocky Ford Irrigation Co.	CNL	1973
Rocky Ford Irrigation Co.	CNL	1975
Rocky Ford Irrigation Co.	Dam-Rep	1977
Southcreek Prim. A WU Irr. Co.	Dam-Res	1982
Westside Irrigation Co.	CNL	1953
Westside Irrigation Co.	Pr-Pipe	1972
BEAVER COUNTY TOTAL	22	
IRON COUNTY		
Newcastle Reservoir Co.	Dam-Res	1955
Newcastle Reservoir Co.	CNL	1961
Newcastle Reservoir Co.	Dam-Enl	1974
Newcastle Reservoir Co.	Spk	1980
Newcastle Reservoir Co.	Dam-Rep	1958
Newcastle Water Co.	Ss	1994
Brian Head Town	Cl-Tank	1979
Brian Head Town	Cl-Well	1993
Brian Head Town	Misc.	1993
Cedar North Fields Irr. Co.	CNL	1958
Enoch City	Cl-Tank	1977
Enoch City	Cl-Tank	1980
Enoch City	Cl-Pipe	1985
Mountain View SSD	CL	1985
Paragonah Canal Co.	Dam-Enl	1979
Paragonah Canal Co.	Pr-Pipe	1966
Paragonah Canal Co.	Pr-Pipe	1986
Paragonah Canal Co.	Div-Dam	1988
Parowan City	Cl-Pipe	1979
Parowan City	Ss	1987
Parowan Reservoir Co.	Dam-Enl	1985
South & West Field Irrigation Co.	Lh-Pipe	1990
Spring Creek & La Verkin Creek Irrigation Co.	Dam-Res	1948

Table 9-1 (Continued)
BOARD OF WATER RESOURCES DEVELOPMENT PROJECTS

Sponsor	Type	Year
Summit Irrigation Stock Co.		
Summit Irrigation Stock Co.	CNL	1959
Summit SSD	Sprinkle	1985
	Cl-Pipe	1982
IRON COUNTY TOTAL	25	
WASHINGTON COUNTY		
Enterprise City	Spr-Dev	1981
Enterprise Res. & Canal Co.	CNL	1961
Enterprise Res. & Canal Co.	Spk	1982
Enterprise Res. & Canal Co.	Dam-Res	1980
WASHINGTON COUNTY TOTAL	4	

Note:
CL-Culinary line
CNL-Canal lining
Div-Diversion
Lh-Low Head
PL-Pipeline
Pr-Pressure
Rep-Repair
Res-Reservoir
Spk-Sprinkler
Ss-Secondary system
WS-Water System

a 325 acre-foot detention basin and a 4,500 foot-long channel and levee to divert flood flows up to 15,500 CFS to Hickory Wash away from existing development. The Corps also constructed a flood control dike in the Shoal Creek drainage near Enterprise.

Another major planning effort was the Bureau of Reclamation Dixie Project. As conceived, this project included agreements for Cedar City to obtain water from Kolob Reservoir on the North Fork of the Virgin River. This would be a transbasin diversion. This is discussed in more detail in Section 9.6.5.

9.2.2 Current Water Planning and Development

Recently, a study was completed of alternatives for bringing water from the Virgin River drainage into the Cedar City area for culinary purposes.[6] Possible sources include tributaries to the North Fork of the Virgin River including Kolob Reservoir, the Santa Clara River and Ash Creek.

New Castle has just completed installation of a pressurized secondary water system. Eight irrigation companies have applied for assistance to complete investigations to comply with the 1990 Utah Dam Safety Act. These are Southcreek Primary "A" Water Users Irrigation Company, Beaver Dam Reservoir Company, Enterprise Reservoir and Canal Company, Paragonah Canal Company, Newcastle Reservoir Company, Kents Lake Reservoir Company, Parowan Reservoir Company and Rocky Ford Irrigation Company.

There is one project currently under construction where financial assistance is provided by the Board of Water Resources. It is the reconstruction of Upper Kents Lake Reservoir in Beaver County.

The Natural Resources Conservation Service has recently completed a feasibility study in the Fiddlers Canyon area. It was determined a project to control the flood water and sediment is currently infeasible.

9.2.3 Environmental Considerations

Water is often viewed as a commodity for people's use with little thought given to other purposes and processes of the hydrologic cycle. Precipitation produces the river and stream flows that can be enjoyed by everyone for many reasons. The Beaver River flows through forested lands providing opportunities for camping, fishing, hunting, hiking and many other recreational activities. Coal Creek and Parowan Creek provide scenic beauty which can be enjoyed in the

comfort of an automobile or by exploring these and other areas on horseback, by hiking or other means. To some, sprinklers irrigating green crops in a desert climate provide a pastoral beauty not found in many arid areas. Proper development can provide an adequate quantity and quality of water for all uses including those so crucial to maintaining healthy wildlife habitats.

Providing instream flows as a beneficial use to maintain fish and wildlife populations, riparian vegetation and stream channels is widely recognized as important. Although construction of reservoirs such as Kents Lake and Red Creek cover some riparian habitat, they provide instream flows during the summer when streams would normally be too low to support a fishery. This is a side benefit to the primary purpose of storing and releasing irrigation water. This should be considered early in future designs.

Other important factors that could affect water use and development are wilderness areas and wild and scenic rivers designations. There is only one designated wilderness area in the basin. This is the Ashdown Gorge Wilderness Area in Coal Creek on the Dixie National Forest. There are no others proposed at this time. There have been some preliminary inventories made of wild and scenic rivers. There are no plans to pursue these any further until a statewide procedure can be established as requested by the governor.

The Cedar/Beaver Basin contains many historic places and artifact sites tieing the present to the past. There are also archeological sites around the area. Future development should take all of these into consideration.

9.3 Policy Issues and Recommendations

One issue is discussed concerning long-range planning.

9.3.1 Long-Range Planning

Issue - Coordinated long-range planning is needed at all levels in the use and management of the water and water-related land resources.

Discussion - The natural resources of the Cedar/Beaver Basin, particularly those related to water, are vitally important to every individual, organization and government entity involved in their conservation, development and use. This makes all aspects of planning, development and use of resources important to all concerned. The ultimate use and disposition of resources should be coordinated among all appropriate entities, including individuals. Land owners, resource users, and administrators of federal, state, and local agencies should strive for acceptable compromises and have a willingness to work toward a common goal.

Long-range plans are a tool to help develop and conserve the existing resources to meet future demands. Water and land provide the basics to support life. Other important considerations include preserving areas for recreation and leisure activities and providing wildlife and habitat for the enjoyment of future generations.

With a growing population, future culinary water use in the basin will increase. To meet this demand, some agricultural land may be taken out of production, water could be imported, or efficiencies could be increased. About the only way water for agricultural lands with short supplies can be firmed up is by reducing irrigated acreages or by increasing application efficiencies.

Federal reserved water claims, instream flows and designation of wild and scenic river segments could also effect future availability of surface water and groundwater. Other withdrawals that could effect water availability include areas of critical environmental concern, special recreation management areas, and Visual Resource Management Class I and II.

Snow making machine at Brian Head

Resource planning can also help where federal laws and mandates dictate use of lands. One example is the growing problem of finding suitable areas for landfills. Local long-range resource plans can require federal agencies to take local desires and needs into consideration.

Long-range planning can also assist in coordinating the development and use of the resources. For example, Parowan, Summit, Paragonah, and north Iron County water companies, Brian Head and Parowan Pumpers Association, all share a common basin and many of the same problems. The upper Beaver Valley and the Minersville-Milford area also have common problems to be resolved.

Past planning has dealt more with resource quantities. Future planning should also emphasize the quality aspects of resources. To assist with this, the present state policy is to provide technical assistance to help counties conduct resource inventories and prepare plans. The resources of the Governor's Office of Planning and Budget have been made available when needed. Additional planning assistance is also available from several state and federal agencies.

Recommendation - Local governments and water user groups should prepare long-range plans concerning the basin's natural resources. Counties should take the lead through their land-use planning process with assistance from state and federal agencies.

9.4 Water Resources Problems

There are several water resources problems to be addressed. These include water quality issues, municipal and industrial water supplies, and irrigation water shortages. Another problem comes up when water use is transferred or from upstream developments. This may involve water rights, change applications, conveyance costs and environmental concerns. Mining of groundwater reservoirs, particularly in the Escalante Valley area, is a major concern. Mining of groundwater with the resultant lowering of the water table will dry up springs, affect water quality and reduce or eliminate some riparian areas.

Many locations in the basin are subject to flash flooding from summer thunderstorms resulting in high instantaneous peak flows causing erosion, sediment deposition and other property damage. In most of the storage reservoirs, part of the capacity is eventually used for sediment storage which reduces the effective water storage capacity.

9.4.1 Water Quality

Water quality is becoming a more serious problem as increasing demands are made on the resource. In most cases, groundwater quality is deteriorating at a faster rate than the surface water quality. Surface water quality measurements were conducted on selected streams during the 1960s. Groundwater quality tests were conducted in the five basins during studies in the 1970s. Refer to Sections 12 and 19 for data on water quality.

9.4.2 Irrigation Water Shortages

Groundwater is either the primary or supplemental source of irrigation water in most areas. In some areas, the groundwater use exceeds the recharge, resulting in declining groundwater levels or mining. If mining of groundwater continues, cost of pumping for irrigation will become prohibitive. This is particularly true in the Beryl-Eterprise area.

Surface water flows fluctuate widely from year to year, as well as between individual months within the year. This is characteristic of surface water supplies in the basin, particularly Coal Creek. (See Section 5, Water Supply and Use). Coal Creek is the only major stream in the Cedar/Beaver Basin without any water storage reservoirs to reduce the flow fluctuations. This results in more pumping of groundwater in some areas during dry years. Coal Creek is a short, steep drainage lacking in adequate vegetative growth to inhibit extreme sediment producing runoff flow volumes. These watershed characteristics separate Coal Creek from most other streams in the basin.

The streamflow volumes in all drainages vary with the precipitation cycles of wet and dry years. There is inadequate reservoir capacity available to provide carry over storage and level out year-to-year supplies. Also, the water supplies are inadequate to allow much additional storage. Where there is reservoir storage for irrigation water, the supplies are more evenly spread over the crop growing season. However, those areas depending primarily on direct flow rights divert most of their irrigation water early in the season when the snow-melt flows are high. These same areas are more likely to experience shortages during the late part of the growing season.

9.4.3 Municipal and Industrial Water Problems

The Cedar City area population is the fastest growing in the basin, mainly because it is the economic and cultural hub. There are also many recreation facilities to attract people. This can create a shortage of good quality culinary water. Currently, all of the

culinary supplies come from either springs or wells. To overcome municipal and industrial shortages in the future, agricultural water, most likely groundwater, will have to be purchased to provide culinary supplies.

9.5 Water Resources Demands and Needs

Municipal and industrial (M&I) water demands will continue to be the catalyst for the transfer of water from other uses. Estimates of population growth given in Section 4 are used to project M&I water needs. Agricultural water uses will decrease slightly as supplies are reallocated to satisfy M&I demands.

9.5.1 Culinary Water Demands

It is estimated the culinary water use will increase by 72 percent or 6,160 acre-feet by the year 2020. This also reflects a conservation factor. See Section 11. The current and projected culinary water diversions and depletions are shown in Table 9-2.[19]

If groundwater is used for culinary water, it will generally not need treatment. The same is true if additional springs can be developed. Surface water will need to be treated to meet culinary water standards.

9.5.2 Secondary Water Needs

Secondary (dual) water systems provide irrigation water for residential and municipal areas.[19] These systems allow the use of lower quality water for landscape and turf irrigation. Parks, golf courses and other large grass areas are ideal candidates for secondary systems along with any other outside uses not requiring water of culinary standards. Many communities in the basin have installed secondary water systems so the potential is not as much here as in other parts of the state. Current and projected diversions and depletions for secondary systems are shown in Table 9-3. The projected diversion needed by the year 2020 is an additional 1,090 acre-feet.

9.5.3 Irrigation Water Needs

The area of the irrigated cropland increased by about 30 percent from 1965 to 1989. As the future population grows, particularly in the Cedar Valley area, some of the new residential and commercial developments may displace presently irrigated farmland. This may result in the irrigation of some new lands. Overall, the irrigated land area is expected to change only slightly in the next 30 years.

Surface supplies are the major source of irrigation water in Beaver Valley, the Minersville area and Parowan Valley. Groundwater supplies the majority of irrigation water in the Milford area, Cedar Valley, and in the Beryl-Enterprise area. Overall, about 42 percent of the irrigation water supply comes from surface water sources. See Section 5.5.1. Also, Table 10-7 in Section 10 shows the current and projected irrigation water diversions and depletions.

9.5.4 Fish and Wildlife Water Needs

There is a requirement to maintain or improve the wetlands and riparian areas, especially those associated with open water areas. These are important habitats for fish and wildlife.

Some areas should be preserved to accommodate amphibians and non-game species. There are areas where habitat can be improved from poor or fair condition to good condition. Waterfowl areas can be

Table 9-2
CURRENT AND PROJECTED CULINARY WATER USE

Year	County			Total	
	Beaver	Iron	Washington (Acre-feet)	Diversion	Depletion
1992	1,580	6,360	670	8,610	4,480
2000	2,440	8,190	770	11,400	5,930
2010	2,590	9,690	940	13,220	6,870
2020	2,630	11,040	1,100	14,770	7,680

Table 9-3
CURRENT AND PROJECTED SECONDARY SYSTEMS WATER USE

Year	County			Total	
	Beaver	Iron	Washington (Acre-feet)	Diversion	Depletion
1992	1,350	1,980	-0-	3,330	2,330
2000	1,410	2,190	-0-	3,600	2,520
2010	1,560	2,590	-0-	4,150	2,910
2020	1,600	2,820	-0-	4,420	3,090

improved by interseeding, stabilizing the water areas and provided nesting facilities. Fisheries can be rehabilitated by using stream bank and channel measures to stabilize streambeds and provide pools. Priorities should be given to areas where there is greater potential for improvement. The current wetland and riparian water uses in the valley areas are shown in Table 9-4.

9.5.5 Recreational Demands

The Cedar/Beaver Basin contains two state parks, one national monument, two national forests, two ski resorts and numerous other recreational areas of various kinds. The recreational activities range from camping, hiking, nature study, hunting, golfing and water sports in the summer to cross-country skiing, snowmobiling, hunting, skiing and sledding in the winter.

Sightseeing is popular at any time of the year. Opportunities for recreation range from the colorful Cedar Breaks National Monument and the majestic Tushar Mountains to the wide expanse of desert landscapes and the old ghost towns from the heyday of mining. Desert flowers and the changing colors of leaves provide vistas of beauty, each in its own way.

Water-based recreation is provided by the lakes and reservoirs in the basin. Minersville Reservoir and the Upper Enterprise Reservoir provide water skiing and boating as well as fishing. Other major water attractions include Red Creek, Yankee Meadows, Puffer Lake, the Kents Lakes, Newcastle and the Lower Enterprise reservoirs. Camping and picnicking facilities are provided at many of these as well as at other locations.

9.6 Water Development and Management Alternatives

There are ways to enhance the existing water supplies. These include reservoir storage, protection of recharge areas, cloud seeding, upper watershed rehabilitation and water conservation.

Making more efficient use of existing water supplies increases the availability for future demands.

Table 9-4
CURRENT WETLAND WATER DEPLETIONS

County	Depletions (Acre-feet)
Beaver/Millard	16,450
Iron/Washington	8,960
Total	25,410

9.6.1 Water Supply Management

Even though much has been accomplished, there are additional opportunities to improve the efficient use and management of the water resources. This applies to all uses. Users can better manage their water supplies by increasing efficiencies which in turn can reduce costs, and by using prudent application of water for landscaping and other outside residential purposes. There is a need to properly manage the groundwater reservoirs in the Cedar/Beaver Basin. Some fears have been expressed that saving of water can result in loss of the right to that water. Provisions should be made to accommodate water savings and protection of water rights. Water managers should always be searching for ways to conserve the available supply so development of other costly sources can be eliminated or postponed. Education and training can be an effective tool.

One of the tools used in planning and design of water projects is computer modeling. This can be used to simulate river systems to determine reservoir yields, hydroelectric power production, water shortages and the effect on the river systems as new developments become operational. Reservoir operation procedures can be fine-tuned with models to maximize the available water for use and minimize any problems associated with changing flow regimes. Computer models are also a useful tool for simulating operation of a groundwater reservoir.

Water conservancy districts can be a means for carrying out resource planning and development. At the present time, there is some support for creating a district in the Cedar Valley area. There is no support for a district in the Parowan Valley or New Castle-Beryl areas. Also, there is no interest in Beaver County for creating a district.

9.6.2 Surface Water Storage Facilities

Over the years, many potential reservoir sites have been investigated to varying degrees of detail. Investigations have been made by the Utah State Engineer, Division of Water Resources, Corps of Engineers and Soil Conservation Service (SCS). Local entities also have conducted investigations on reservoir sites. In 1973, the SCS documented 44 potential reservoir sites.[62] They evaluated these sites on the basis of geology, availability of water, topography, local interest and better utilization of water resources. The SCS selected 10 sites, which appeared favorable, for future analysis. Nine of these, and one other site subsequently selected by other entities, are included in Table 9-5 and on Figure 9-1. Future water storage reservoirs will only be feasible if constructed as multipurpose projects. Planning for these projects generally includes biological surveys, but these surveys should always be made.

One alternative is construction of a storage reservoir on Urie Creek. This structure would store high quality water for municipal and industrial use in Cedar City. However, the project would reduce the flow of high quality water into Coal Creek, thus increasing the concentration of total dissolved solids. This project may also decrease the recharge to the Cedar Valley groundwater reservoir.

9.6.3 Water Conveyance and Delivery Systems

Much has been done to improve the conveyance and delivery systems for all uses. Pipelines and canal lining have been installed to reduce the loss of irrigation water. Many off-farm systems have been installed, but there is still a potential for installing over 50 miles of pipelines and canal lining. Water management with sprinkler systems is very effective in increasing on-farm efficiencies. Gated pipe is also effective where pressurized systems are not available or too costly.

Improvements have been made in systems delivering and distributing municipal and industrial water. However, there are still locations where systems need to be upgraded. By keeping distributions systems in good condition, current water supplies can be stretched to meet most of the future needs.

9.6.4 Groundwater Management

The Cedar/Beaver Basin area consists of five major groundwater basins in varying degrees of development. There is also a smaller groundwater reservoir in the Sulphurdale area. Groundwater is the primary water source for much of the area (Refer to Section 5, Water Supply and Use and Section 19, Groundwater).

Present withdrawals are mostly by individuals, private companies or municipalities. The withdrawals are not coordinated except through the legal appropriations system administered by the state engineer. Existing groundwater use is lowering the water table in some basins, drying up some seeps and springs, causing ground subsidence and allowing water from lower quality zones to intrude into better quality zones. See Section 7.3.2 for a discussion on groundwater management.

9.6.5 Transbasin Diversions

A proposal was investigated to divert water from Deep Creek in the upper Virgin River basin into Coal

Table 9-5
POTENTIAL RESERVOIRS[62]

No.	Name	Stream	Location T R S	Capacity (Ac-ft)	Surface Area (Ac)	Dam Height (ft)
1	Coop Valley Sinks	Hoosier Creek	34S 8W 25	2,390	150	[b]
2	Indian Creek[a]	Indian Creek	27S 7W 35	1,110	40	83
3	Milk Ranch[a]	Indian Creek	27S 6W 34	800	32	84
4	North Creek	North Creek	28S 6W 29	790	26	87
5	Little Creek	Little Creek	33S 7W 32	1,100	59	71
6	Summit	Summit Creek	34S 10W 36	1,500	80	[b]
7	Urie	S Creek Coal Cr	37S 10W 8	5,000	85	170
8	Holt Canyon	Meadow Creek	37S 16W 10	1,250	80	54
9	Upper Pinto	E Fork Pinto Cr	38S 15W 1	1,060	57	64
10	Indian Rock	Shoal Creek	37S 17W 7	1,680	122	97

[a] Alternate sites for water storage.
[b] Value unknown.

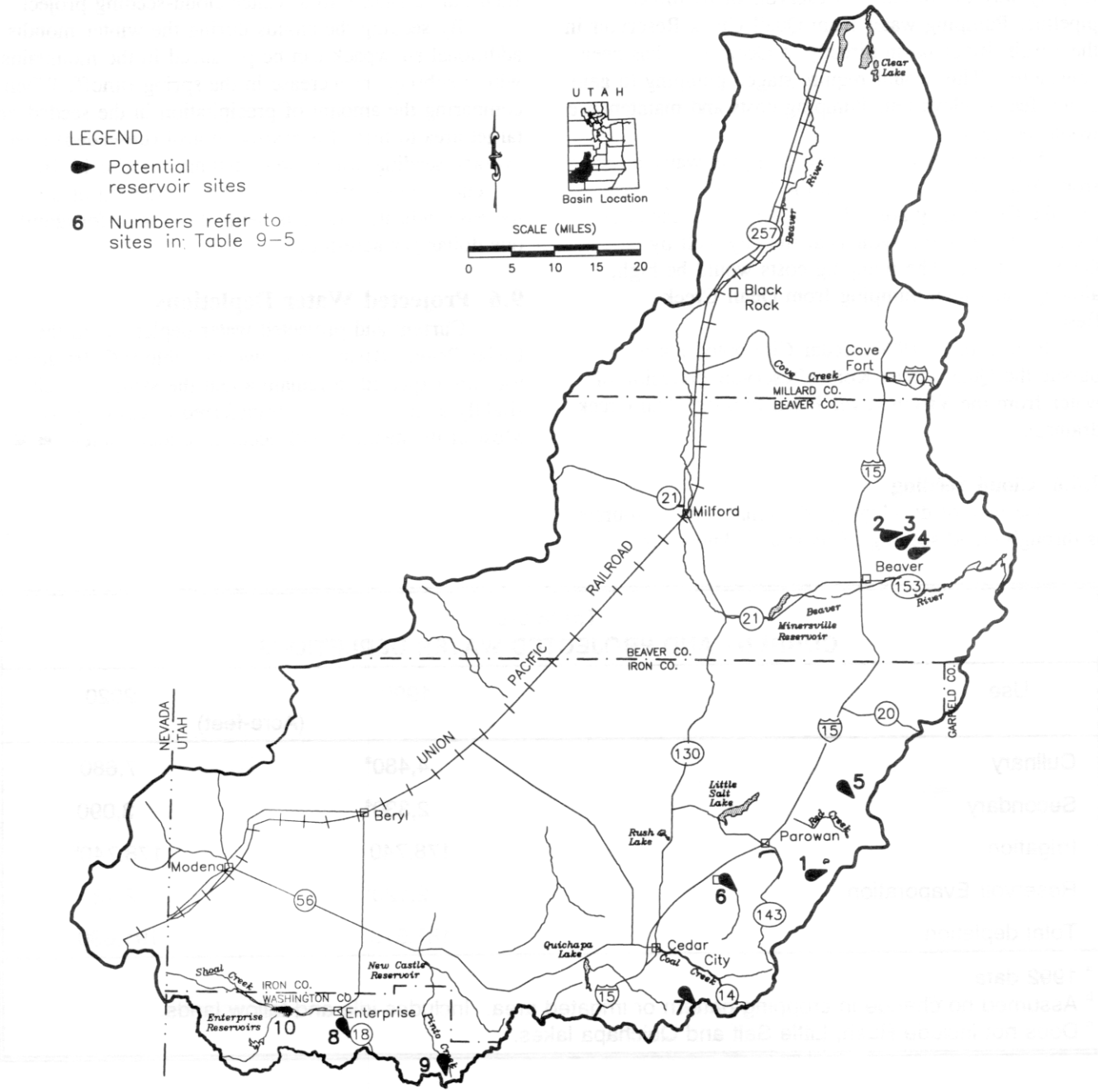
Creek. This water would then flow into the Cedar City area to provide municipal and industrial water and recharge the groundwater reservoir.

During the early 1950s, a discussion between Iron County and Dixie Project officials was held to explore diverting Virgin River water into Cedar City. Assisting in the discussion, the Utah Water and Power Board appointed a committee to consider the needs of Washington and Iron counties. After some preliminary considerations, Cedar City looked to Kolob Creek in the Virgin River basin. In August 1953, Cedar City entered into an agreement with Washington County and the newly formed Kolob Reservoir and Storage Association (water users from Hurricane and Washington Fields). The agreement was to construct the Kolob Dam and Reservoir with Cedar City repaying two-fifths of the cost of construction and allowing them to acquire the entire water supply in Kolob Reservoir when the Dixie Project was completed. When the Dixie Project was abandoned in the early 1970s, a substitute reservoir was needed to comply with the agreement. A study was completed in 1982 by the Utah Division of Water Resources for conveying water from Kolob Reservoir to Cedar City and constructing Bullock Dam for use by Washington County water users as a replacement supply for Kolob water.

In 1984, an agreement between Cedar City and Washington County Water Conservancy District (WCWCD) outlined opportunities for Cedar City to develop water in the Virgin River basin. The agreement provided that if Cedar City decided not to construct facilities for transbasin diversion of water from the upper Virgin River drainage by December 1994, WCWCD would reimburse Cedar City for the amount paid plus interest towards the cost of construction of the Quail Creek project. The WCWCD would then purchase Cedar City's two-fifths interest in Kolob Reservoir along with associated water rights and property.

Cedar City and the Division of Water Resources completed a study in March 1993 to evaluate water supply, demand and development opportunities for Cedar City. The report includes an updated evaluation of several transbasin diversion alternatives, some of which have been previously studied.[6] Some of these alternatives are briefly described below.

Figure 9-1
POTENTIAL RESERVOIR SITES
Cedar/Beaver Basin



SOURCE: USDA WATER AND RELATED LAND RESOURCES SUMMARY REPORT, BEAVER RIVER BASIN & STATE ENGINEERS OFFICE.

The existing diversion of water from the upper Santa Clara River in Grass Valley could be increased by diverting water upstream from Pine Valley Reservoir. This water could then be delivered to Cedar City by way of Newcastle Reservoir or by direct pipeline. Pumping water from Quail Creek Reservoir in the Virgin River basin directly to Cedar City has been considered. This would require staged pumping to gain 3,300 feet in elevation. Pumping costs and maintenance would be high.

Another alternative entails pumping water directly from Ash Creek Reservoir in the Virgin River Basin into the Cedar City area. This water would recharge the groundwater reservoir near the city well by Quichapa Lake. The pumping costs would be high, although less than pumping from Quail Creek Reservoir.

In December 1994, Cedar City opted not to pursue the Quail Creek-Kolob Reservoir diversion of water from the Virgin River Basin into the Coal Creek drainage.

9.6.6 Cloud Seeding

One way of developing additional water resources is through cloud-seeding. This is an acknowledged method of increasing the water supply within a selected area. To be the most effective, the right conditions must exist. The state of Utah recognized this need and, through the Division of Water Resources it has given financial assistance to a winter cloud-seeding project.

By seeding the clouds during the winter months, additional snowpack can be produced in the mountains with a subsequent increase in the spring runoff. When comparing the amount of precipitation in the seeded or target area to that of a nearby control (unseeded) area, average seeding effects were estimated to be 12-16 percent. A conservative economic evaluation of this increase indicates water is being developed for about one dollar per acre-foot.

9.6 Projected Water Depletions

Current and projected water depletions in the Cedar/Beaver Basin are shown in Table 9-6. Irrigation uses are expected to remain about the same or decline slightly as more water is transferred to culinary use. Most of the declines will occur in Cedar Valley. ■ ■

Table 9-6
CURRENT AND PROJECTED WATER DEPLETIONS

Use	1990 (Acre-feet)	2020 (Acre-feet)
Culinary	4,480[a]	7,680
Secondary	2,330[a]	3,090
Irrigation	178,740	178,740[b]
Reservoir Evaporation	2,120[c]	2,120[c]
Total depletion	187,670	191,630

[a] 1992 data
[b] Assumed no change in cropping pattern or irrigated area. Includes idle and fallow lands.
[c] Does not include Rush, Little Salt and Quichapa lakes.